

Monorchiidae (Trematoda, Digenea) from Fishes of Japanese and Adjacent Waters

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Abstract Eight species of monorchiid digeneans are described from fishes of Japanese and adjacent waters. Four new species are named: *Diplomonorchis kureh* sp. nov. from *Diagramma pictum* of Japan, *Hurleytrema carangoidis* sp. nov. from *Carangoides orthogrammus* of Palau, *Hurleytrema marukoban* sp. nov. from *Trachinotus blochii* of Japan, and *Proctotrematoides synapturae* sp. nov. from *Synaptura marginata* of Japan and *S. orientalis* of Palau. Two new combinations are made: *Hurleytrematoides chaetodontis* (Yamaguti, 1952) comb. nov., formerly *Diplolasiotocus chaetodontis*, from *Heniochus acuminatus* of Indonesia and Japan, and *Monorcheides macrorchis* (Hafeezullah & Siddiqi, 1970) comb. nov., formerly *Allobacciger macrorchis*, from *Scolopsis monogramma* of Japan. Two genera have been synonymized: *Diplolasiotocus* Yamaguti, 1952 is a synonym of *Hurleytrematoides*, and *Allobacciger* Hafeezullah & Siddiqi, 1970 a synonym of *Monorcheides*. Two known species are redescribed: *Ovipusillus mayu* Dove & Cribb, 1998 from *Gnathanodon speciosus* of Philippines, and *Paramonorcheides pseudocaranxi* Dove & Cribb, 1998 from *Selar crumenophthalmus* of Japan.

Key words: Digenea, Monorchiidae, new species, new combination, marine fish, Japan, Philippines, Palau, Indonesia.

This paper deals with eight species of Monorchiidae (Trematoda, Digenea) including four new species and two new combinations from fishes of Japanese and adjacent waters. Digeneans were fixed in AFA under slight pressure, stained with Heidenhain's hematoxylin and mounted in Canada balsam. The specimens are deposited in the National Science Museum, Tokyo (NSMT). Measurements are given in millimeters unless otherwise stated.

I am grateful to the staff of the following fishermen's cooperative associations for giving me facilities during the field work: Setouchi, Kagoshima Prefecture and Nago, Okinawa Prefecture, Japan. I also wish to thank Mr. J. Araki of the Meguro Parasitological Museum, Tokyo (MPM) for kindly lending me specimens.

Family Monorchiidae

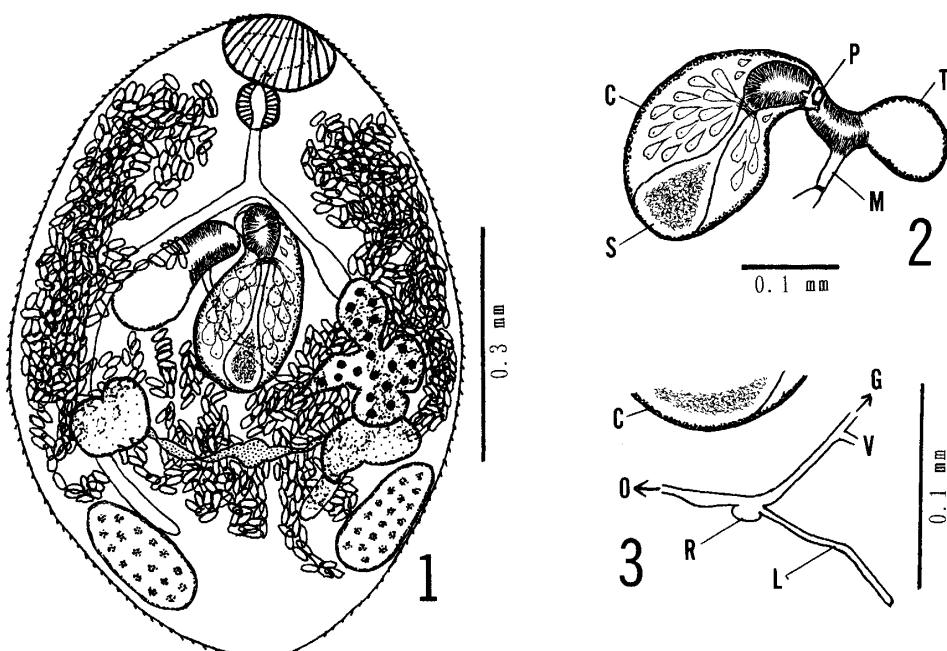
Diplomonorchis kureh sp. nov.

(Figs. 1–3)

Material. From mid-intestine of *Diagramma pictum* (Thunberg) (fam. Haemulidae), Amami-ooshima, Kagoshima Prefecture, Japan, 17–XI–1989 (NSMT-P1 3796, holotype & 9 paratypes).

Description. Based on 10 specimens. Body ovoid, 0.52–0.82 long by 0.47–0.59 wide. Tegument spinose. Oral sucker subterminal, 0.10–0.13×0.14–0.17; prepharynx up to 35 µm long; pharynx 56–69×51–71 µm; esophagus 0.02–0.07 long; caeca terminating mid- to posterior level of testes. Acetabulum 0.06–0.09×0.06–0.09. Sucker ratio 1:0.41–0.60. Forebody 41–60% of body length.

Testes longitudinally elongated, symmetrical, extracaecal, near middle of hindbody or more posteriorly; right testis 0.14–0.19×0.05–0.08 and left testis 0.13–0.19×0.05–0.08. Posttesticular



Figs. 1-3. *Diplomonorchis kureh* sp. nov. — 1. Entire worm, dorsal view (holotype, NSMT-Pl 3796). 2. Terminal genitalia, ventral view. 3. Ovarian complex, ventral view.

space 6–10% of body length. Cirrus sac large, $0.18\text{--}0.31 \times 0.12\text{--}0.17$, sometimes arcuate, nearly midline or slightly right to midline, partly or entirely overlapping acetabulum, extending posterior level of acetabulum to some distance posterior to it; containing oval seminal vesicle $0.06\text{--}0.16 \times 0.04\text{--}0.12$, pars prostatica, prostatic cells, and cirrus with fur-like spines $22 \mu\text{m}$ long. Genital atrium unarmed. Genital pore median, slightly posterior to caecal bifurcation.

Ovary three or four lobed, $0.15\text{--}0.26 \times 0.08\text{--}0.15$, anterior to right vitellaria or testis. Oviduct arising from left margin of ovary, connecting with rudimentary seminal receptacle which is situated a short distance posterior to cirrus sac, giving off Laurer's canal and then receiving common vitelline duct. Laurer's canal opening dorsally midway between acetabulum and posterior end of body. Uterus occupying almost all available space posterior to pharyngeal level, entering terminal organ near middle of anterior spiny portion. Eggs thin-shelled, $27\text{--}32 \times 14\text{--}16 \mu\text{m}$. Terminal organ $0.12\text{--}0.18$ long, $50\text{--}83\%$ length of cirrus sac, left to midline, sometimes overlapping acetabulum in part; posterior vesicle unspined, $0.06\text{--}0.11 \times 0.06\text{--}0.09$ and anterior portion with

spines similar to those of cirrus. Vitellaria in two lateral compact masses with incisions or irregular uneven surface, anterior to or in contact with testes, overlapping caeca; the right $0.08\text{--}0.14 \times 0.05\text{--}0.14$ and the left $0.10\text{--}0.14 \times 0.05\text{--}0.10$. Excretory vesicle tubular, ending in testicular zone; occasionally with a single concretion $40\text{--}43 \times 25\text{--}35 \mu\text{m}$; pore terminal.

Remarks. The present new species is most similar to *Diplomonorchis hopkinsi* Nahhas & Cable, 1964, but differs from it in the cirrus and the anterior portion of the terminal organ lined with fur-like spines, the vitellaria composed of compact masses and lying anterior to or in contact with the testes, and larger eggs. In *D. hopkinsi*, the cirrus and the terminal organ have minute spines (judging from their Figure 44, the spines are minute triangular-shaped), the vitellaria consist of four to six follicles on each side and lying mainly dorsomedian to the testes, rarely extending anterior to the midlevel of the ovary, and the eggs 13 to 15 by 9 to 11 μm . The name *kureh* is from the Japanese local name of the host.

***Hurleytrema carangoidis* sp. nov.**
(Figs. 4–6)

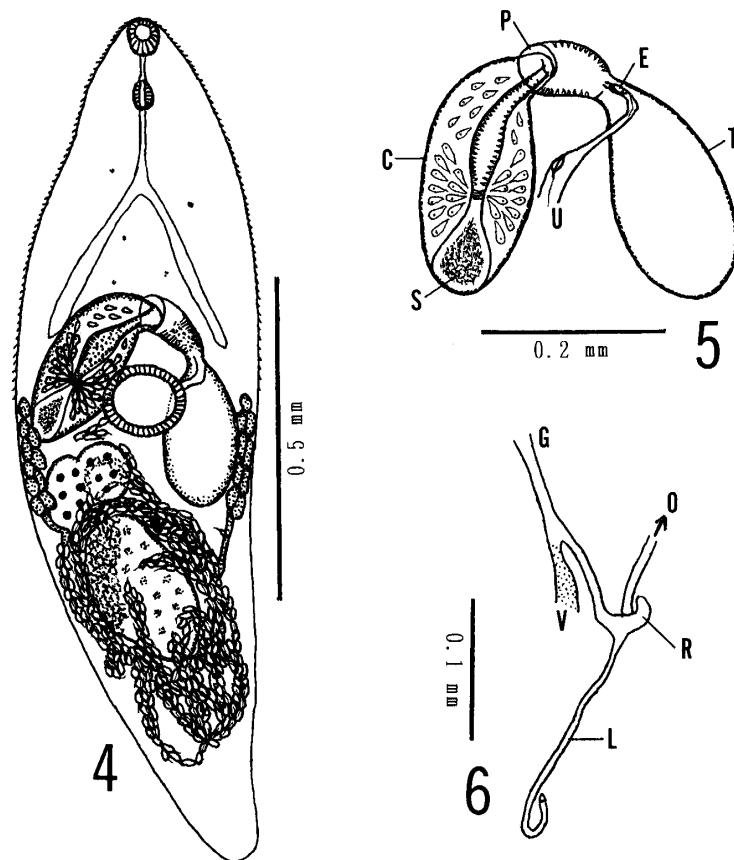
Material. From intestine of *Carangoides orthogrammus* (Jordan & Gilbert) (fam. Carangidae), Palau, western Caroline Islands, 4–VII–1980 (NSMT-Pl 2407, holotype & 3 paratypes).

Description. Based on 4 specimens. Body spindle-shaped, 1.11–1.39 long by 0.36–0.45 wide. Tegument spinose, sparse posteriorly. Eye-spot pigment present. Oral sucker subterminal, 56–69×54–61 μm ; prepharynx 18–31 μm long; pharynx ovoid, 43–48×36–38 μm ; esophagus 77–122 μm long, bifurcating nearer pharynx than acetabulum; caeca slender or swollen, ending just anterior to acetabulum or in acetabular zone. Acetabulum 112–138×120–143 μm . Sucker ratio 1:2.23–2.42. Forebody 40–45% of body length.

Testis single, longer than wide, 0.24–0.27×0.12–0.15, in middle of hindbody. Posttesticular space 19–23% of body length. Two vasa efferen-

tia arising from anterior margin of testis, running forward and entering internal seminal vesicle without forming vas deferens. Cirrus sac slightly arcuate, 0.30–0.42×0.12–0.14, extending postacetabular level or ovarian zone; including oval seminal vesicle 89–115×59–92 μm ; pars prostatica with prostatic cells, and eversible cirrus with thorn-shaped spines 7–9 μm long. Genital atrium unarmed. Genital pore median or slightly submedian, a short distance anterior to acetabulum.

Ovary varying from slightly irregular to nearly lobated, 0.11–0.15×0.06–0.10, dextral, usually between acetabulum and testis. Oviduct arising from middle portion of ovary, running backward, giving off rudimentary seminal receptacle and Laurer's canal, then running forward, receiving common vitelline duct and entering Mehlis' gland. Laurer's canal opening dorsally in testicular zone. Uterus first ascending near acetabulum, then strand-like appearance, filling a large portion of postacetabular space; metraterm 0.10–



Figs. 4–6. *Hurleytrema carangoidis* sp. nov. — 4. Entire worm, ventral view (holotype, NSMT-Pl 2407). 5. Terminal genitalia, ventral view. 6. Ovarian complex, dorsal view.

0.21 long, entering terminal organ near junction of its spiny and unspined portions. Terminal organ a little arcuate, $0.28\text{--}0.32 \times 0.08\text{--}0.13$; posterior portion vesicular, unarmed, 0.15–0.28 long; anterior portion with thorn-shaped spines, similar to those of cirrus, $9\text{--}12 \mu\text{m}$ long. Vitelline follicles in two lateral clusters, between levels of acetabulum and ovary. Vitelline duct overlapping anterior to middle portion of testis. Eggs $25\text{--}28 \times 15\text{--}16 \mu\text{m}$, with filament about $50 \mu\text{m}$ long at anopercular end. Excretory vesicle short, saccate, reaching near posttesticular level; pore terminal.

Remarks. This species occurred with *Anamorochis ulua* Yamaguti, 1970 in the same host individual.

The genus *Hurleytrema* includes seven species, of them the following five species have elongated bodies: *H. ovo caudatum* Srivastava, 1939, *H. eucinostomi* Manter, 1942, *H. longitestis* Bravo-Hollis, 1956, *H. shorti* (Nahhas & Powell, 1965) and *H. hainanense* Shen, 1990. The present new species differs from them by having short caeca which terminate just anterior to the acetabulum or in the acetabular zone, and an acetabulum over twice as large as the oral sucker.

Hurleytrema marukoban sp. nov.

(Figs. 7–9)

Material. From pyloric caeca of *Trachinotus blochii* (Lacepède) (fam. Carangidae), Nago, Okinawa Prefecture, Japan, 11–III–1996 (NSMT-Pl 4889, 2 paratypes); and pyloric caeca of *T. blochii*, Nago, 2–XII–1996 (NSMT-Pl 4994, holotype & 10 paratypes).

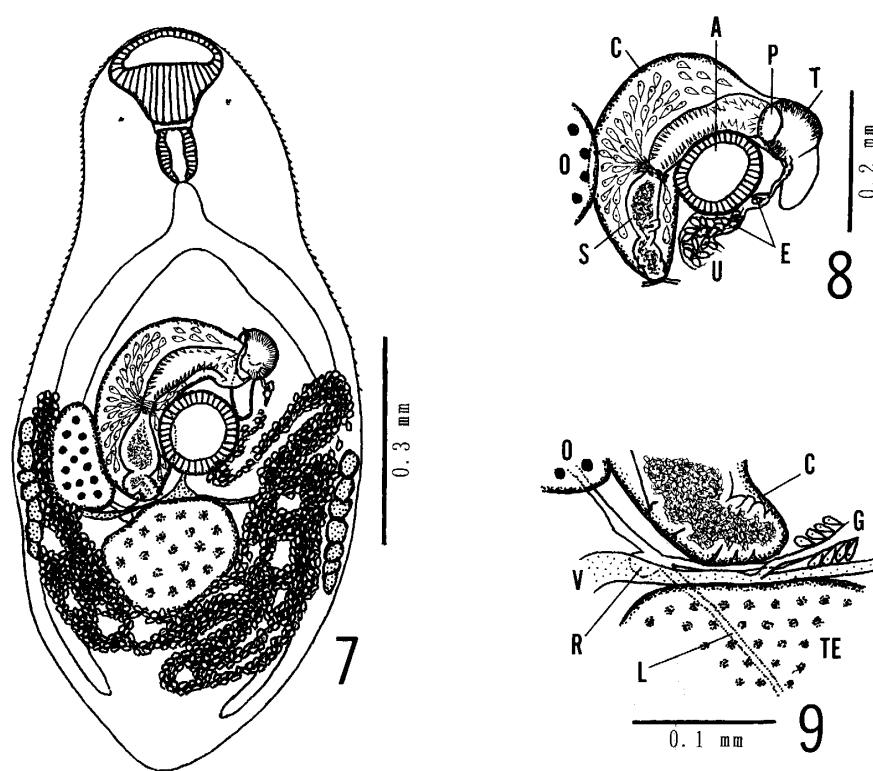
Description. Based on 13 specimens. Body pyriform or nearly elliptical, 0.88–1.35 long by 0.44–0.52 wide. Tegument spinose, sparse posteriorly. Eyespots at levels between posterior portion of oral sucker and esophagus. Oral sucker funnel-shaped, $0.11\text{--}0.16 \times 0.15\text{--}0.19$; prepharynx up to $13 \mu\text{m}$ long; pharynx $0.07\text{--}0.09 \times 0.06\text{--}0.08$; esophagus $38\text{--}143 \mu\text{m}$ long, bifurcating nearer pharynx than acetabulum; caeca terminat-

ing almost to posterior end of body. Acetabulum $0.11\text{--}0.14 \times 0.10\text{--}0.14$. Sucker ratio 1:0.59–0.78. Forebody 47–56% of body length.

Testis single, oval, $0.13\text{--}0.23 \times 0.17\text{--}0.33$, median, slightly posterior to acetabulum or middle of hindbody. Cirrus sac large, arcuate, $0.32\text{--}0.43 \times 0.11\text{--}0.14$, extending to testicular level. Internal seminal vesicle tubular, sinuous, $0.13\text{--}0.19$ long in a straight line; pars prostatica short, $9\text{--}26 \mu\text{m}$ long; ducts of prostatic cells opening into pars prostatica; cirrus $0.12\text{--}0.20$ long, with thorn-shaped spines $8\text{--}15 \mu\text{m}$ long. Cirrus spines bigger toward the distal end. Genital atrium unarmed. Genital pore immediately anterior to acetabulum, median to slightly sinistral.

Ovary spherical to oval, $0.13\text{--}0.17 \times 0.07\text{--}0.10$, between right body margin and cirrus sac, at acetabular level, overlapping right caecum. Terminal organ inverted flask-shaped, $0.12\text{--}0.17$ long; 28–47% length of cirrus sac; anterior portion subglobular, $0.04\text{--}0.08 \times 0.06\text{--}0.09$, with slender spines $20 \mu\text{m}$ long; and posterior portion cylindrical, $0.06\text{--}0.09 \times 0.04\text{--}0.06$, unspined. Oviduct arising from posterior portion of ovary, running posterosinistrally, connecting with rudimentary seminal receptacle, giving off Laurer's canal, receiving common vitelline duct, and entering Mehlis' gland. Laurer's canal opening middorsally at mid- to posterior level of testis. Mehlis' gland usually posterosinistral to acetabulum. Uterus filling most of body posterior to acetabulum; distal end forming muscular metraterm, entering terminal organ near junction of spiny and unspined portions. Eggs $18\text{--}21 \times 12\text{--}15 \mu\text{m}$, with filament maybe $20\text{--}30 \mu\text{m}$ long. Vitelline follicles in lateral groups, arranged longitudinally, from level of anterior or posterior end of acetabulum to near middle or posterior border of testis. Excretory vesicle saccular, reaching near testis; pore terminal.

Anomalous specimen. One anomalous specimen with two testes was found with normal specimens of this species. The body is 0.95 long by 0.49 wide. Two testes lie symmetrically near the middle of the hindbody: the right testis measures 0.18×0.14 and the left 0.14×0.16 . The other fea-



Figs. 7-9. *Hurleytremma marukoban* sp. nov. —— 7. Entire worm, ventral view (holotype, NSMT-Pl 4994). 8. Terminal genitalia, ventral view. 9. Ovarian complex, ventral view.

tures are the same as those of the normal specimens.

Remarks. Thomas (1959) described *Hurleytremma trachinoti* as a new species from *Trachinotus goreensis* of Ghana. My material was detected from the same genus of host of Japan. The present new species differs from *H. trachinoti* in that the latter has smaller acetabulum ($68-94 \times 73-94 \mu\text{m}$) and cirrus sac ($189-242 \times 65-74 \mu\text{m}$), vitellaria extending well beyond the testis in the posterior extent, and much larger eggs ($25-31 \times 12-16 \mu\text{m}$) (Fischthal & Thomas, 1969). Further, the terminal organ in *H. trachinoti* contains a spherical posterior portion (Thomas, 1959), but that organ in the present species is a flask-shaped on the whole, consisting of subglobular anterior and cylindrical posterior portions. The name *marukoban* is from the Japanese name of the host.

Hurleytrematoides chaetodontis

(Yamaguti, 1952) comb. nov.

(Figs. 10-12)

Material. From intestine of *Heniochus acuminatus* (Linnaeus) (fam. Chaetodontidae), Fukaura, Ehime Prefecture, Japan, 20-XII-1972 (NSMT-Pl 1139); intestine of *H. acuminatus*, Ambon, Indonesia, 25-I-1993 (NSMT-Pl 4324); and intestine of *H. acuminatus*, Nago, Okinawa Prefecture, Japan, 29-IX-1994 (NSMT-Pl 4707).

Description. Based on 12 specimens. Body slender, somewhat spatulate, 1.76-2.24 long by 0.34-0.43 wide. Tegument spinose, sparse posteriorly. Oral sucker subterminal, $0.10-0.19 \times 0.13-0.21$; prepharynx 0.03-0.07 long; pharynx globular, $0.07-0.09 \times 0.07-0.11$; esophagus 0.05-0.29 long, bifurcating midway between pharynx and acetabulum; caeca terminating a short distance anterior to posterior end of body. Acetabulum $0.11-0.14 \times 0.11-0.17$. Sucker ratio 1:0.67-1.11. Forebody 24-42% of body length.

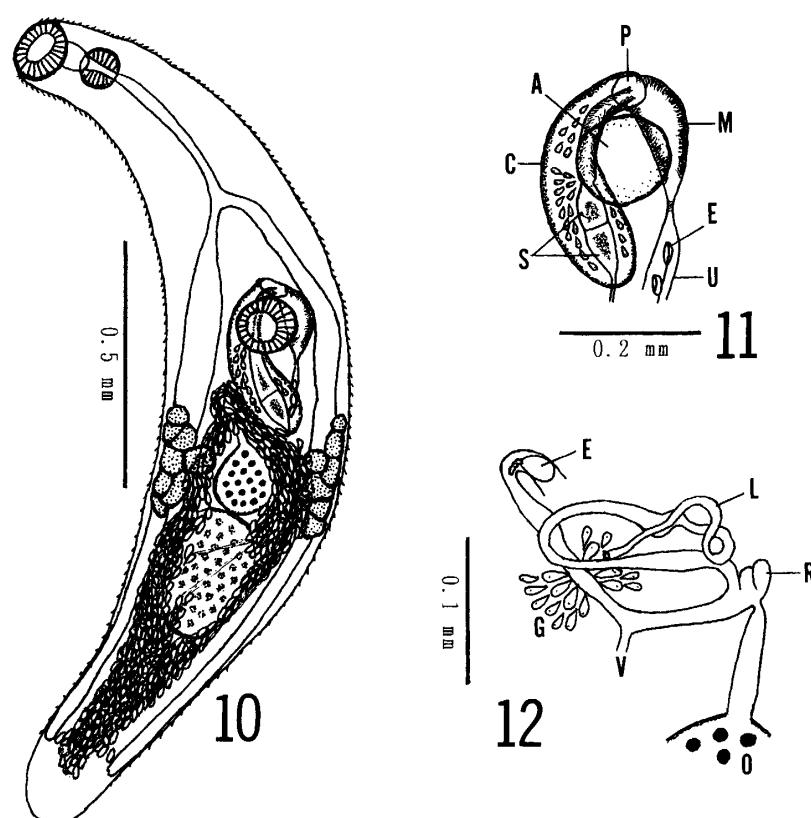
Testis single, longitudinally elongated, 0.26-

$0.50 \times 0.13-0.18$, near middle of hindbody. Posttesticular space 17–25% of body length. Two vasa efferentia arising from anterior margin of testis, running forward, uniting with each other to form vas deferens near anteroovarian level, and entering internal seminal vesicle. Vasa efferentia occasionally not uniting with each other. Cirrus sac claviform, slightly arcuate, $0.32-0.58 \times 0.07-0.12$, partly overlapping acetabulum, posterior extent from midway between acetabulum and ovary to preovarian level; including bipartite seminal vesicle, pars prostatica, prostatic cells and eversible cirrus. Cirrus lined with thorn-shaped spines $14-23 \mu\text{m}$ long. Genital atrium unarmed. Genital pore median, immediately anterior to acetabulum.

Ovary globular, $0.12-0.19 \times 0.10-0.17$, median, just anterior to or in contact with testis. Oviduct arising from anterior margin of ovary, running forward, connecting with rudimentary seminal receptacle, giving off Laurer's canal, receiving common vitelline duct, and entering

Mehlis' gland. Laurer's canal long, winding, opening middorsally near posterior end of cirrus sac. Mehlis' gland slightly left to midline, between cirrus sac and ovary. Uterus forming three to five longitudinal loops, of them one or two loops reaching near posterior end of body. Metraterm well-developed, $0.16-0.26 \times 0.03-0.07$, 41–77% length of cirrus sac, lined with hair-like spines $10-20 \mu\text{m}$ long, left to, sometimes partly overlapping acetabulum. Eggs $33-41 \times 17-23 \mu\text{m}$, with anopercular filament 10–20 times length of egg (long filaments always overlap with each other, so the accurate length is impossible to measure). Vitellaria in two lateral clusters, extending from a level midway between acetabulum and ovary to preovarian or pretesticular level. Excretory vesicle saccular, reaching caecal termination.

Remarks. Yamaguti (1952) described *Diplosasiotocus chaetodontis* as a new genus and species from *Chaetodon awuga* (*auriga*?) (fam. Chaetodontidae) from Macassar, Indonesia. The



Figs. 10–12. *Hurleytrematoides chaetodontis* (Yamaguti, 1952) comb. nov. — 10. Entire worm, ventral view (original, NSMT-Pl 4324). 11. Terminal genitalia, ventral view. 12. Ovarian complex, dorsal view.

type series consists of a holotype and a paratype (MPM. Coll. No. 22930), both are extremely in poor condition. In particular, the paratype is a young adult with poorly-formed eggs, to make the matters worse, it is too macerated and degenerated to examine the internal structure. Reexamination revealed the holotype to have a single testis instead of two testes. Yamaguti (1952) mistook the ovary for an anterior testis, and probably the Mehlis' gland for an ovary. Two vasa efferentia arise from the anterior margin of the testis, run forward, connect with each other midway between the cirrus sac and ovary, and enter the cirrus sac. The caeca probably terminate near the end of the body, but the ovarian complex is entirely out of shape. The above features coincide with those of the genus *Hurleytrematoides*. The genus *Diplolasiotocus* accordingly becomes a synonym of *Hurleytrematoides*, with *Hurleytrematoides chaetodontis* (Yamaguti, 1952) as a new combination.

My specimens have common features with *H. chaetodontis*. The ovary and testis are longitudinally contiguous. The genital pore lies anterior to the acetabulum. The vitellaria consist of two lateral groups, between the acetabulum and the anterior portion of testis. Egg is provided with a long filament 10 to 20 times the length of the eggshell. The type-host is the same chaetodontid fish as mine. The type-locality Macassar (=Ujung Pandang) is near Ambon, one of the localities my material collected. I provisionally placed my specimens in *H. chaetodontis*, and described them based on my non-macerated specimens.

Monorcheides macrorchis

(Hafeezullah & Siddiqi, 1970) comb. nov.
(Figs. 13-15)

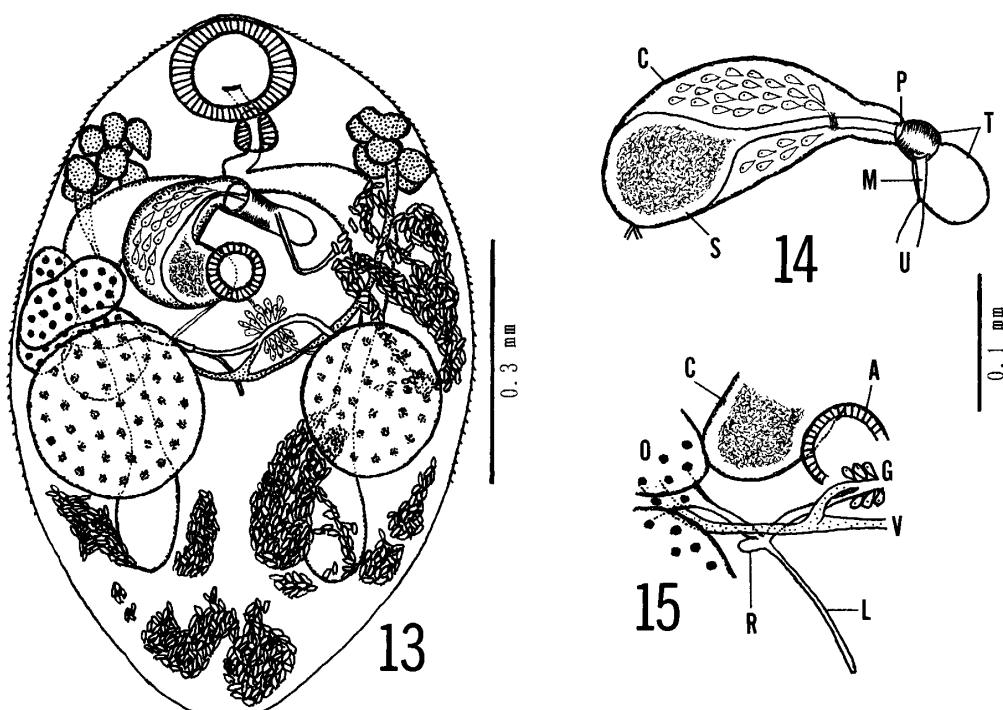
Material. From intestine of *Scolopsis monogramma* (Cuvier) (fam. Nemipteridae), Nago, Okinawa Prefecture, Japan, 19-V-1983 (NSMT-Pl 2782a); upper intestine of *S. monogramma*, Nago, 18-V-1993 (NSMT-Pl 4393); pyloric caeca and upper intestine of *S. monogramma*,

Nago, 21-V-1993 (NSMT-Pl 4410); and pyloric caeca of *S. monogramma*, Nago, 30-IX-1994 (NSMT-Pl 4711).

Description. Based on 15 specimens. Body small, ovoid, 0.42-0.90 long by 0.29-0.53 wide. Tegument spinose, sparse posteriorly. Oral sucker subterminal, 84-133×110-161 μm ; prepharynx short, up to 28 μm long; pharynx 33-56×31-56 μm ; esophagus 15-50 μm long, bifurcating nearer pharynx than acetabulum; caeca passing dorsal to testes and terminating near middle of posttesticular space. Acetabulum 46-79×48-73 μm . Sucker ratio 1:0.41-0.50. Forebody 33-48% of body length.

Testes rounded to ovoid, symmetrical, just postacetabular, near midbody; right testis 0.11-0.23×0.12-0.24 and left testis 0.10-0.20×0.13-0.19. Posttesticular space 28-40% of body length. Cirrus sac arcuate to straight, 0.11-0.22×0.07-0.10, right to acetabulum, extending posteriorly mid- to postacetabular level or rarely beyond acetabulum to midtesticular level; containing oval seminal vesicle 0.05-0.17×0.05-0.08, short pars prostatica with prostatic cells and eversible cirrus. Cirrus without spines. Genital atrium unarmed. Genital pore median, slightly post-bifurcal.

Ovary composed of three to four lobes, 0.09-0.19×0.11-0.19 as a whole, dextral, overlapping partly right caecum and forward portion of right testis. Terminal organ 0.07-0.09 long, left to midline, 38-80% length of cirrus sac; anterior portion with fur-like spines; posterior portion saccular, 31-59×28-64 μm , unspined. Oviduct arising from left margin of ovary, running to left, connecting with rudimentary seminal receptacle, giving off Laurer's canal, receiving common vitelline duct, and entering Mehlis' gland which usually lies posterior or posterosinistral to acetabulum. Laurer's canal opening mid-dorsally near midlevel of testes. Uterus descending near posterior end of body, then passing anterior to left testis; metraterm 77-128 μm long, entering terminal organ near junction of spiny and unspined portions. Eggs 19-24×10-13 μm . Vitelline follicles in lateral groups, 7



Figs. 13-15. *Monorcheides macrorchis* (Hafeezullah & Siddiqi, 1970) comb. nov. — 13. Entire worm, ventral view (original, NSMT-Pl 4393). 14. Terminal genitalia, ventral view. 15. Ovarian complex, ventral view.

to 10 on each side, between levels of pharynx and ovary. Excretory vesicle I-shaped, extending almost near or some distance posterior to acetabulum.

Remarks. Hafeezullah and Siddiqi (1970) described this species as a new genus and species from *Scolopsis vosmeri* from India. My present material occurred in the same genus of host from Japan. Hafeezullah and Siddiqi (1970) incorrectly stated that "caeca short, presumably reaching testicular region" and "excretory vesicle V-shaped; arms reaching level of prepharynx," and placed this species in the family Fellodistomidae. Actually the caeca terminating well beyond the testes, and the excretory vesicle is I-shaped, extending almost near or some distance posterior to the acetabulum. Machida and Uchida (2001) described the second species of *Allobacciger*, *A. centropygis*, from *Centropyge heraldi* (fam. Pomacanthidae) from Japan and transferred *Allobacciger* from the family Fellodistomidae to the Monorchiidae because it possesses a terminal organ and a uterus entering the terminal organ near its middle.

Allobacciger is closely related with *Monorcheides*. The differences between the two seem to be shape and position of testes, posterior extent of uterus, position of vitellaria, and shape of excretory vesicle. In *Allobacciger*, the testes are rounded to ovoid, lying at the acetabular or just postacetabular level, the uterus enters in the posttesticular space, the vitellaria are entirely preacetabular, and the excretory vesicle is an I-shaped or Y-shaped with extremely short arms. In *Monorcheides*, the testes are elongated, lying in the hindbody, the uterus is not distributed in the posttesticular space, the vitellaria are situated at the acetabular or postacetabular level, and the excretory vesicle may be a Y-shaped. However, exceptions occur: *Monorcheides popovicii* Szidat, 1950 has a uterus intruding in the posttesticular space. *M. hafeezullahi* Bijukumar, 1997 possesses elongated testes lying in the hindbody, a uterus reaching to the posttesticular space, and entirely preacetabular vitellaria. These species share with combined features of *Allobacciger* and *Monorcheides*. Martin (1940) suspected the Y-shaped excretory vesicle described for some

monorchiids is probably a median vesicle receiving expanded arms. Manter and Pritchard (1961) claimed that minor differences in the distribution of the vitellaria should not be of more than generic value in some monorchiids, and should be only specific one.

I reduce therefore *Allobacciger* to a synonym of *Monorcheides*, with *Monorcheides macrorchis* (Hafeezullah & Siddiqi, 1970) and *M. centropygis* (Machida & Uchida, 2001) as new combinations.

***Ovipusillus mayu* Dove & Cribb, 1998**

(Figs. 16 & 17)

Material. From lower intestine and rectum of *Gnathanodon speciosus* (Forsskål) (fam. Carangidae), Palawan, Philippines, 17–XI–1988 (NSMT-Pl 3597).

Description. Based on 7 specimens. Body fusiform, 1.10–1.42 long by 0.41–0.61 wide. Tegument spinose. Oral sucker 51–79×71–94 μm ; prepharynx 10–33 μm long; pharynx 46–66×46–61 μm ; esophagus 38–107 μm long, bifurcating closer to pharynx than acetabulum; caeca terminating anterior to or slightly overlapping testes dorsally. Acetabulum 82–102×71–99 μm . Sucker ratio 1:0.86–1.13. Forebody 31–43% of body length.

Testes longitudinally elongated, almost symmetrical, attached to lateral body margin, near equator; right testis 0.19–0.32×0.07–0.15 and left testis 0.15–0.28×0.07–0.15. Cirrus sac voluminous, 0.28–0.47×0.18–0.24, extending mid- to posttesticular level. Internal seminal vesicle 0.08–0.14×0.05–0.09. Pars prostatica with tall transparent cells posteriorly and connecting with middle portion of cirrus. Cirrus eversible, bent, surrounded by small glandular cells, lined with thorn-shaped spines, and provided with small unspined vesicle at the proximal end. Genital atrium unspined. Genital pore median, slightly anterior to acetabulum.

Ovary multi-lobed, 0.25–0.36×0.16–0.29, median, usually just posterosinistral to cirrus sac. Postovarian space 23–33% of body length.

Oviduct arising from anterodextral lobe of ovary, giving off rudimentary seminal receptacle and Laurer's canal, receiving common vitelline duct, and entering Mehlis' gland. Laurer's canal running backward, almost straight, and opening dorsally near posterior edge of ovary. Uterus filling most of posttesticular space, passing left to cirrus sac, and connecting with muscular metraterm 0.06–0.10 long which enters terminal organ at posterior end. Eggs small, 11–14×9–10 μm . Terminal organ 0.14–0.30×0.06–0.09, 38–78% length of cirrus sac, surrounded by glandular cells and lined with thorn-shaped spines entirely. Vitellaria in two lateral clusters, from level of genital pore to anterior end of testes or slightly overlapping them. Vitelline ducts running posteriorly to form common vitelline duct in forward portion of ovary. Excretory vesicle not determined; pore terminal.

Remarks. This species was initially described by Dove and Cribb (1998) from *Gnathanodon speciosus*, the same species of host of my material, from Australia. With the exception of being slightly larger bodies with correspondingly slightly larger organs, my specimens agree fairly well with their description.

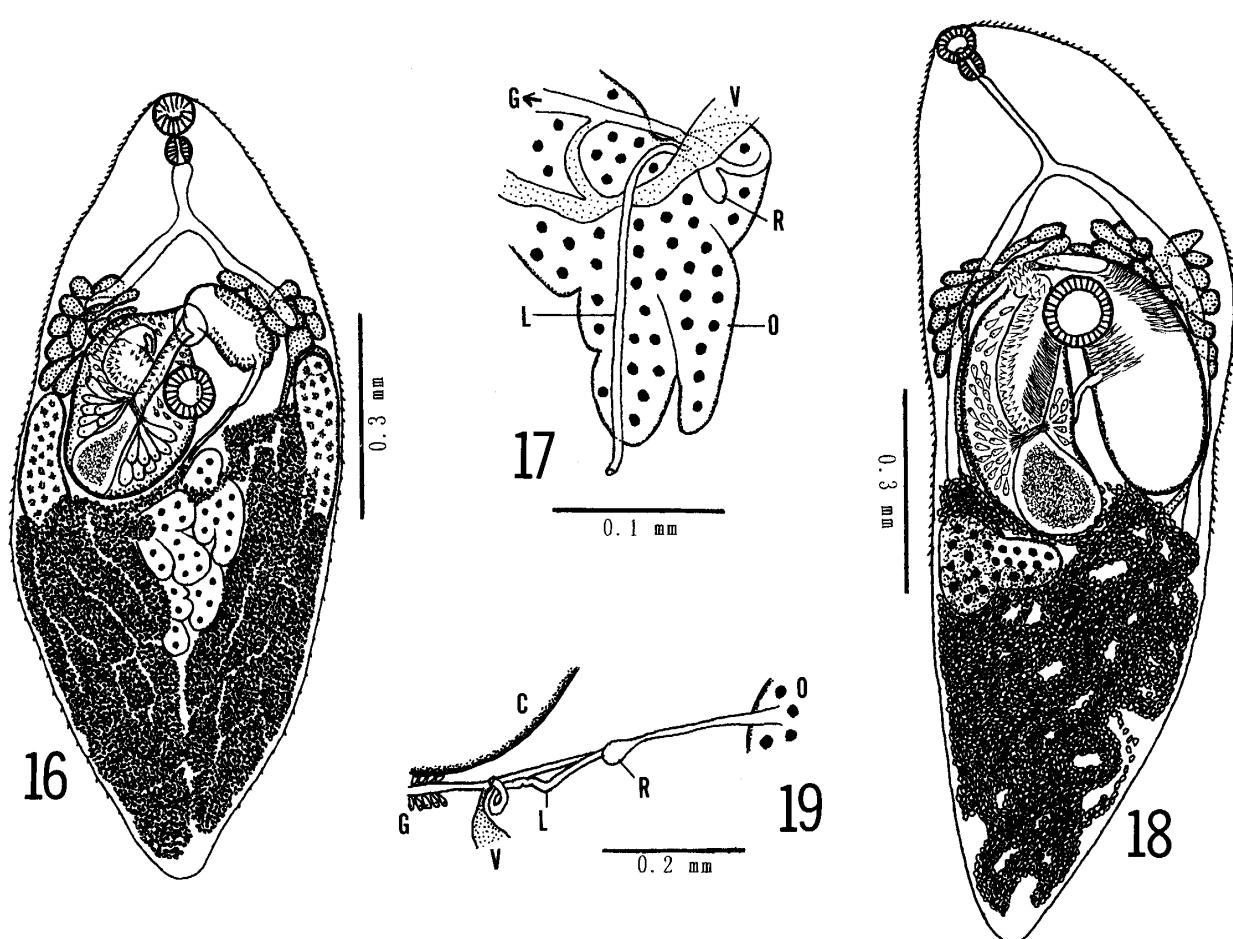
Dove and Cribb (1998) might have overlooked the following two points. First, they incorrectly stated that "Laurer's canal absent." In my specimens, however, Laurer's canal is observed to open near the posterior end of the ovary as shown in Fig. 17. Second, there is no mention of a metraterm in the original description, but the uterus connects with the terminal organ by a distinct muscular metraterm in my specimens.

Paramonorcheides pseudocaranxi

Dove & Cribb, 1998

(Figs. 18 & 19)

Material. From upper intestine of *Selar crumenophthalmus* (Bloch) (fam. Carangidae), Nago, Okinawa Prefecture, Japan, 30–I–1990 (NSMT-Pl 3849); and pyloric caeca of *S. crumenophthalmus*, Nago, 8–III–1996 (NSMT-Pl 4876).



Figs. 16 & 17. *Ovipusillus mayu* Dove & Cribb, 1998. — 16. Entire worm, ventral view (original, NSMT-Pl 3597). 17. Ovarian complex, dorsal view.

Figs. 18 & 19. *Paramonorchoides pseudocaranxi* Dove & Cribb, 1998. — 18. Entire worm, ventral view (original, NSMT-Pl 3849). 19. Ovarian complex, dorsal view.

Description. Based on 10 specimens. Body elongated, 1.25–1.67 long by 0.39–0.53 wide, blunt anteriorly and tapering posteriorly. Tegument spinose, sparse posteriorly. Oral sucker sub-terminal, 43–79×69–97 μm ; prepharynx up to 36 μm long; pharynx 43–51×34–43 μm ; esophagus 0.13–0.19 long; caeca ending near level of posterior border of cirrus sac or in ovarian zone. Acetabulum 97–117×94–133 μm . Sucker ratio 1:1.23–1.78. Forebody 32–47% of body length.

Testes obscured by numerous eggs, much longer than wide, 0.45–0.54 long, symmetrical, maybe in contact with each other, between posterior border of cirrus sac and near posterior end of body. Right testis sometimes partly overlapping ovary. Cirrus sac and terminal organ voluminous, usually overlapping acetabulum entirely. Cirrus sac arcuate, 0.33–0.52×0.16–0.21, extending in

ovarian zone or touching anterior margin of left testis. Internal seminal vesicle oval, 0.17–0.28×0.12–0.15; pars prostatica 13–38 μm long, ducts of prostatic cells opening into pars prostatica; cirrus evversible, 0.16–0.23 μm long. Cirrus spines stout, slightly curved, 28–75 μm long; anteriormost ones thorn-shaped, 20–25 μm long. Genital atrium unarmed. Genital pore median, anterior to acetabulum.

Ovary subglobular, sometimes nearly triangular, 0.11–0.18×0.11–0.22, dextral, near middle of hindbody, contact with or overlapping forward portion of right testis. Oviduct arising from anterior portion of ovary, running to left, giving off rudimentary seminal receptacle and Laurer's canal, receiving common vitelline duct, and entering Mehlis' gland. Laurer's canal running to left, opening middorsally immediately posterior

to cirrus sac. Uterus extensive, filling almost all space posterior to cirrus sac and terminal organ, overlapping testes and ovary, passing forward between cirrus sac and terminal organ; distal portion forming muscular metraterm 0.08–0.12 long, entering terminal organ at posterior end of spiny portion. Eggs 18–21×12–14 μm . Terminal organ 0.21–0.33 long, 40–80% length of cirrus sac; posterior portion unspined, 0.11–0.21×0.11–0.24; anterior portion with slender spines 21–60 μm long. Vitelline follicles in two lateral groups, along exterior to cirrus sac and terminal organ, from anterior to genital pore to slightly posterior to acetabulum or near middle of cirrus sac, usually confluent anteriorly; two vitelline ducts running posteriorly along exterior to cirrus sac and terminal organ, and uniting just posterior to cirrus sac to form common vitelline reservoir. Excretory vesicle saccular, inverted triangular; pore terminal.

Remarks. This species was originally described by Dove and Cribb (1998) from *Pseudocaranx dentex* (fam. Carangidae) and *Diagramma labiosum* (fam. Haemulidae) from Australia. Compared with the original description, my specimens have larger bodies with correspondingly larger organs except for egg size. Further, my specimens differ somewhat from the original description. The acetabulum lies consistently pre-equatorial, the cirrus sac does not extend in the testicular zone, and no eyespot pigment is observed. The testes are much longer and seem to extend to near the posterior end of the body, but the exact shape and position are obscured by numerous eggs. I provisionally place my specimens in *P. pseudocaranxi*.

***Proctotrematoides synapturae* sp. nov.**
(Figs. 20–22)

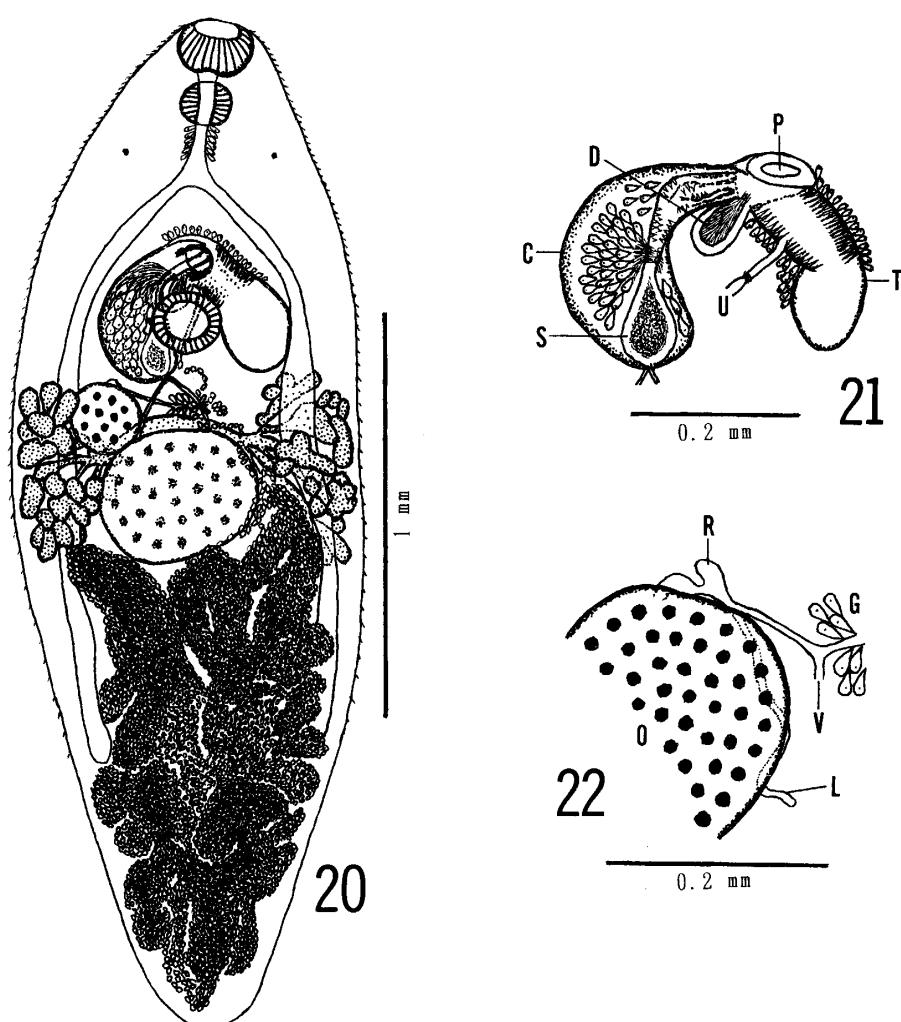
Material. From intestine of *Synaptura marginata* Boulenger (fam. Soleidae), Ishigaki-jima, Okinawa Prefecture, Japan, 4–III–1973 (NSMT-Pl 1320, 6 paratypes); intestine of *S. marginata*, Nago, Okinawa Prefecture, 16–V–1983 (NSMT-Pl 2767, holotype & 7 paratypes); intestine of *S.*

marginata, Nago, 31–V–1988 (NSMT-Pl 3396, 1 paratype); and intestine of *S. orientalis* (Bloch & Schneider), Palau, western Caroline Islands, 18–VII–1990 (NSMT-Pl 3931, 5 paratypes).

Description. Based on 20 specimens. Body plump, 1.78–2.80 long by 0.58–0.88 wide. Tegument spinose, sparse posteriorly. Oral sucker terminal, 0.11–0.16×0.14–0.21; prepharynx 20–55 μm long; pharynx 0.07–0.12×0.11–0.15; esophagus 0.05–0.23 long, covered with glandular cells, and bifurcating approximately midway between suckers; caeca terminating near middle of posttesticular space. Eyespots in pharyngeal to esophageal region. Acetabulum 0.12–0.19×0.15–0.21. Sucker ratio 1:0.84–1.03. Forebody 25–37% of body length.

Testis single, subglobular, usually a little wider than long, 0.21–0.32×0.22–0.43, median, near equator of body. Posttesticular space 34–50% of body length. Two vasa efferentia arising from antero-dextral and -sinistral border of testis, respectively, running forward and entering internal seminal vesicle without forming vas deferens. Cirrus sac claviform, arcuate, 0.34–0.58×0.12–0.19, dextral to and partly overlapping acetabulum, extending posteriorly to near preovarian level; containing oval seminal vesicle 0.12–0.22×0.05–0.10; pars prostatica 18–60 μm long, ducts of prostatic cells opening into pars prostatica; and eversible cirrus with thorn-shaped spines 8–15 μm long. Genital atrium unarmed. A small flask-shaped diverticulum, 0.09–0.14×0.05–0.08, opening to genital atrium at the base between distal end of cirrus sac and that of terminal organ. The diverticulum with thick muscular wall, lined with long hair-like spines 70–80 μm long directed forward. Genital pore median or slightly sinistral, immediately anterior to acetabulum.

Ovary globular, 0.11–0.23×0.13–0.23, anterodextral to and almost always in contact with testis. Oviduct arising from anterior border of ovary, expanded at the beginning, connecting with rudimentary seminal receptacle, giving off Laurer's canal, receiving common vitelline duct, and entering Mehlis' gland. Laurer's canal open-



Figs. 20-22. *Proctotrematoides synapturae* sp. nov. — 20. Entire worm, ventral view (holotype, NSMT-Pl 2767). 21. Terminal genitalia, ventral view. 22. Ovarian complex, ventral view. Abbreviations: A, acetabulum; C, cirrus sac; D, atrial diverticulum; E, egg; G, Mehlis' gland; L, Laurer's canal; M, metraterm; O, ovary; P, genital pore; R, seminal receptacle; S, seminal vesicle; T, terminal organ; TE, testis; U, uterus; V, vitelline duct.

ing mid-dorsally near postovarian level. Mehlis' gland sinistral to ovary. Uterus extensive, filling most of posttesticular space, then passing along left side of testis and dorsal to acetabulum before joining metraterm. Metraterm 38-72 μm long, entering terminal organ near middle of spiny portion. Eggs thick-shelled, 21-26 \times 15-18 μm . Terminal organ 0.23-0.32 long, sinistral to and sometimes partly overlapping acetabulum, 51-71% length of cirrus sac; proximal portion vesicular, unspined, 0.06-0.11 \times 0.05-0.10; distal portion covered with glandular cells and lined with slender spines 15-25 μm long. Vitelline follicles in two lateral ramified groups, not confluent each

other, overlapping caeca, in ovarian-testicular zone. Vitelline ducts running transversely along anterior margin of testis. Excretory vesicle long tubular, reaching near intestinal bifurcation; pore terminal.

Remarks. The genus *Proctotrematoides* is characteristic in having a flask-shaped muscular diverticulum attached to the genital atrium, and a long tubular excretory vesicle of preacetabular extent. Manter and Pritchard (1961) were hesitant as to whether this genus was valid because the atrial diverticulum was unreliable as a generic characteristic. Instead of atrial diverticulum, Sey and Nahhas (1997) suggested vitallaria extending

longitudinally in lateral fields between the acetabulum and the testis as a generic characteristic. However, the atrial diverticulum is clearly observed in the type series of *P. pisodontophidis* (MPM. Coll. No. 22918) and the present new species. I consider the atrial diverticulum a characteristic of *Proctotrematoides*.

Sey and Nahhas (1997) assigned five species to *Proctotrematoides*: *P. pisodontophidis* Yamaguti, 1938, *P. ophichthii* Fischthal & Thomas, 1969, *P. diacanthi* Zaidi & Khan, 1977, *P. indicum* Ahmad & Gupta, 1985 and *P. kuwaiti* Sey & Nahhas, 1997. Later, Dutta and Manna (1998) described *P. yamagutii* as a new species from India.

The present new species is most like *P. pisodontophidis* which has been obtained from *Pisodonophis cancrivorus* (fam. Ophichthidae) of Japan, but is distinguished from the latter in extent of caeca and distribution of vitellaria. The present species has caeca terminating near the middle of the posttesticular space instead of reaching at or near the posterior end of the body. Some of my immature or young adult specimens show the caeca extending near the posterior end of the body. However, the caeca become short as the worm grows.

Reexamination of the type series of *P. pisodontophidis* reveals that the vitellaria consist of numerous small follicles, extending from the pre- or postacetabular level or occasionally a short distance posterior to the acetabulum to the posttesticular level, confluent widely dorsal to the testicular or ovarian-testicular zone. The present new species has vitellaria composed of two lateral ramified groups, not confluent each other, in the ovarian-testicular zone.

A postoral circular muscle ring was observed on the specimens of *P. ophichthii* and *P. kuwaiti* (Fischthal & Thomas, 1969; Sey & Nahhas, 1997). Fischthal and Thomas (1969) stated that Yamaguti (1938) might have overlooked the ring for *P. pisodontophidis*, but I could not find such a ring in the type series of *P. pisodontophidis* and the present new species.

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